

# WASHINGTON SCIENCE TRENDS

## HIGHLIGHTS

- \* Nuclear Space Applications
- \* Military Communications
- \* Stop Watch Tests
- \* Research Checklist
- \* Publication Checklist

Vol. III No. 24

Feb. 29, 1960

### Nuclear Applications in Space

Atomic Energy Commission officials have indicated to the House Committee on Science and Aeronautics that they feel the National Aeronautics and Space Administration (NASA) may be overlooking substantial technical progress made in recent months on applications of nuclear power in space.

Here is a summary of major recent developments:

**SNAP 10:** AEC officials are enthusiastic over the possibilities of this auxiliary nuclear power device which would have no moving parts and could theoretically operate "almost forever" delivering some 300 watts of electrical power. Atomics International is prime contractor for this reactor-powered, thermoelectric generator. Disc-shaped fuel elements of material similar to that used in the SNAP 2 space power system are currently being manufactured. Construction of a thermoelectric generator is now being negotiated with industry. It is hoped that a nuclear test can take place late this summer. AEC believes that a fully working unit could be available for space missions in as little as two years. Such a unit would weigh about 350 pounds but would be considered much more flexible in application than batteries and solar cells currently employed. However, the AEC is impatiently awaiting word that this type of system will be employed by the NASA in its space exploration program.

**Project Orion:** This unique and promising method of future space propulsion is being studied for the Advanced Research Projects Agency by General Atomics and is based on a system in which a series of small nuclear explosions creates propulsion for huge space platforms. Despite highly encouraging preliminary studies Dr. Herbert York, Director of Defense Research and Engineering has warned that there will be no funds available from ARPA when the current program of expenditures runs out in August. York tried, without success, to have the NASA provide the one to two million dollars required for a one year follow-on. Now this concept faces the possibility of becoming an "orphan" in the familiar maze of conflicting space programs and agencies. One further difficulty is the current ban on nuclear testing, although it is believed that feasibility could be established through the use of conventional high explosives.

**Project Rover:** AEC officials indicate that more funds could also expedite work on Project Rover, the national nuclear rocket propulsion program. They would particularly like to see NASA show more interest in earlier use of this system as an upper stage for conventionally powered space boosters.

### Military Communications Trends

Here is a summary of current problems and future programs in the field of military communications as outlined during the past week by Ralph H. Clark, Asst. Director, Defense Research and Engineering:

- \* Long-Line Communications: The three large, fixed, long-line systems of the Army, Navy and Air Force consist of trunk line high frequency (HF) radio circuits employing 12 kilocycle single side-band transmissions providing three voice channels and up to 16 teletype channels of 100 word per minute capacity. These systems are augmented by simpler radio teletype circuits, with a few manual radio circuits remaining.

Air Force has built and plans further construction of Very High Frequency (VHF) ionospheric scatter and Ultra High Frequency (UHF) tropospheric scatter systems. Army VHF system, recently completed, extends from Hawaii west across the Pacific. These radio systems are supplemented to a growing extent by leased capacity from American common carriers -- particularly the two existing trans-Atlantic telephone cables, and the San Francisco-Hawaii telephone cable.

These long-line systems are, in effect, separate networks which are being used by a number of operators with separate fixed "hot-line" systems. Some 15 or 20 different defense networks are interwoven in the domestic civilian trunk system and extend overseas through allocated channels and on leased facilities. Probably the largest of these are the SAC communications network and the Sage system. The Air Force's planned COMLOGNET is an example of a large logistics system of this type.

- \* Future Trends: Total investment in Defense long-haul facilities is about \$2 billion, and about \$160 million is spent each year for leased commercial facilities. Industry is cautioned that any future system "must be built" from the complex systems now operating. The consolidation of the three major systems is now contemplated by the Department of Defense. This might be done by having the three existing military organizations operate different parts of the joint network. Consolidation, it is believed, can increase channel usage, improve the availability of alternate facilities in case of circuit interruption, and make the use of high-speed automatic switching feasible for many applications.

Scatter systems are thought to offer a worthwhile addition to existing facilities where transmitting and receiving sites can be properly located in terms of spacing, local environment and similar conditions. Meteor reflections are also under active investigation for this purpose.

- \* Terminal Switching Equipment will see extensive re-engineering so as to provide extensive circuit switching for handling voice, teletype circuits in groups, and for so-called stream data, digital and otherwise. These facilities will be augmented by message switching systems providing much advanced capability for automatic high-speed handling of message routing, relaying and distribution.

Continued . . . .

- \* Command Control and Support Systems: The growing use of automatic information-handling systems employing large computer-like devices for data processing is causing severe problems in communications programming. It is alleged that a number of these systems, planned or in operation for logistics, intelligence and other command and support functions, have been started without regard for the demands which will be placed upon communications resources.

A number of efforts are now underway to re-examine these systems in terms of basic requirements, technical feasibility, capability and availability to meet stated requirements. The relations of several individual systems is also being studied, with an appraisal expected by next summer. One such system is said to employ a communications control center with dual automatic switching control computers, each with about five times the capacity of the IBM 704. This system contemplates the handling of upwards of 40,000 messages in 15 minutes following an alert warning.

Transmission problem associated with the use of such devices include high reliability and quality which is difficult, if not impossible, to attain through high-frequency systems and imposes near-insurmountable demands on many other radio systems. This may bring increasing reliance upon submarine telephone cables.

- \* Satellite Systems appear attractive for certain future military communication applications. In various stages of research or development are the repeater-type equatorial satellite and the use of passive reflectors such as those involved in the Echo Project of the National Aeronautics and Space Administration. Much interest is centered about proposals for a family of six or more carefully controlled satellites in polar orbits which could be used with properly designed ground systems to provide communications to polar regions which are difficult to reach by other means -- particularly if high frequency transmission is disrupted by natural or other causes.

By 1966-68 there may be available a 24-hour synchronous satellite system operating above a fixed spot on the equator and controlled and stabilized to maintain position and attitude. However, this would depend upon the development of new electronic components, and the attainment of reliability in the electronic and electromechanical control systems, the development of adequate boosters and similar aspects. If successful, this type of system may provide the U.S. with the capacity for relaying via space almost any volume and type of communications desired between distant points on the surface of the earth.

- \* Future Challenge:

"The big challenge to American defense management, both industrial and governmental," Parker states "is to get these big systems back under control. We must learn better how to define requirements and translate them into system specifications and we then must understand the relation between availability, capability and cost. If delivery of the operational system slips, or the capability deteriorates such that the system does not meet the threat or need, we have made no contribution to national security no matter how large or technically interesting the project. On the other hand, if the cost keeps going up to the point that the sponsoring agency can no longer fund it, the effect is the same."

### Stop Watch Performance Measurement

Methods for measuring stop-watch performance have been developed at the National Bureau of Standards. The techniques may provide a more realistic basis for predicting reliability and may be useful in stop watch manufacturing and design.

Shock resistance test also indicated that watches protected by a tight-fitting sponge rubber cover, about one quarter inch thick, provide unusual resistance to damage.

(Further details available. Single copies free. Write Office of Technical Information, National Bureau of Standards for Summary Technical Report, Stop-Watch Performance)

### Navigation System Procurement

Federal Aviation Agency expects procurement of the distance measuring equipment (DME) portion of its Very High Frequency Direction Radio Range (VOR/DME) navigation system will begin this year. The equipment is to supply another link in the planned short range navigation system for the entire United States that will meet international standards.

(For copies of the DME (ground portion) specifications write Mr. Harvey Bresler, Room 2802, Tempo 4, Federal Aviation Agency, Washington 25, D.C.)

### Rust Preventives Sought

U.S. Naval Experiment Station, Annapolis, Md., is searching for superior rust preventives which can be used for high pressure hydraulic systems that operate on phosphate ester fluids. Such fluids, which are fire resistant, are being used in aircraft elevator pumps and submarine hydraulic systems. Conventional rust preventives have proved to be incompatible with the butyl rubber packing, seals and gaskets now required. A new compound, a tri-aryl phosphate ester has been developed, and has proved satisfactory. However, the Laboratory is still seeking longer-term protection, without the loss of any other necessary property.

### AEC Filter Inspection

Atomic Energy Commission has designated two "quality assurance stations" for the inspection and testing of high-efficiency particulate filters. Commission says that "significant quantities" of such filters stocked by its contractors have been found defective. Service will be provided by the Chemical Corps Arsenal, Edgewood, Maryland and the General Electric-AEC establishment at Richland, Washington.

(For details write Safety and Fire Protection Branch, Office of Health and Safety, U.S. Atomic Energy Commission, Washington 25, D.C.)

### Federal Education Programs

Closer coordination between Federal agencies in the field of scholarships, fellowships and other programs will be sought by J. Kenneth Little, newly named Director, Survey of Federal Programs in Higher Education.

### Research Checklist

( ) Oxygen Recovery System: Studies for the Air Force Research and Development Command indicate that the reduction of carbon dioxide with hydrogen and recovery of breathable oxygen by electrolysis of water appears to be a superior method of providing oxygen for long space flights. Apparatus for such a system is said to have "potentially a low weight, great reliability and good efficiency with low power and energy consumption." The reaction involved has been studied extensively by the gas industry but has not been generally applied to problems in astronautics.

(R&D by John F. Foster, Battelle Memorial Institute, Columbus, Ohio, reported to American Institute of Chemical Engineers)

( ) Central Ship Monitoring System: The electronic apparatus of an entire Navy ship may be monitored with a centralized display console recently devised. Any malfunction or failure reportedly could be relayed to the monitoring center immediately, with the location of the trouble pin-pointed. It is also believed that the system would detect marginal operation so that preventive maintenance can be applied.

(R&D by Engineering Division, Stanford Research Institute, Menlo Park, Calif. for Bureau of Ships, U.S. Navy)

( ) Tungsten for High Temperature Coatings: Research by the National Bureau of Standards has lead to the development of a vapor deposition process by which tungsten can reportedly be plated on metal surfaces. The method involves reducing gaseous tungsten hexafluoride with hydrogen by passing it over the heated object to be plated. At temperatures above 300° centigrade the tungsten is deposited on the hot surface. The only other reaction product, hydrogen fluoride, passes out with the excess of hydrogen. Method is expected to be used in coating rocket and missile nozzles and jet engine parts. The technique can also be used in the fabrication of tungsten articles.

(R&D by W.E. Reid and A. Brenner, Electrodeposition Group, U.S. National Bureau of Standards, Washington 25, D.C.)

( ) Propellant Tank Models: Studies for the National Aeronautics and Space Administration indicate that reduced scale models, when dynamically similar, can provide a practical means of studying and developing solutions for large elastic-wall propellant tanks in rockets. The work is connected with attempts to reduce or eliminate the problem of propellant "sloshing" which can adversely affect vehicle performance and stability.

(Report available. Single copies free. Write NASA, 1520 H Street, N.W. Attn: Code BID for NASA Technical Note D-99)

Publication Checklist

- ( ) Dry Cells and Batteries, a handbook which includes new tests, up-to-date data, and covers new types of dry cells from the standpoint of specifications. Batteries for use with transistors are included. 20 pages. 25 cents. (Write Superintendent of Documents, Government Printing Office, Washington 25, D.C. for Pub. C 13.11:71)
- ( ) Government Patent Policies, the complete transcript of 1959 hearings on patent policies of Departments and Agencies of the Federal Government. 453 pages. Single copies free. (Write Select Committee on Small Business, U.S. Senate, Washington 25, D.C. for Hearings - Government Patent Policies)
- ( ) Gas Lubricated Bearings, a bibliography of 290 references in this field prepared by the Franklin Institute Laboratories for the U.S. Government. Includes a resume of most references. 107 pages. \$2.50. (Write OTS, U.S. Department of Commerce, Washington 25, D.C. for Publication PB 161-017)
- ( ) Cerium Extraction Equipment, a report on the separation and purification of the rare-earth elements by liquid-liquid extraction. Covers development of the basic process variables and closed batch system employing spray columns. 14 pages. Single copies free. (Write Publications-Distribution Section, U.S. Bureau of Mines, 4800 Forbes Avenue, Pittsburgh 13, Pa., for Report of Investigation No. 5536)
- ( ) Helicopter Maintenance, an Army handbook now available designed to provide basic information on principles, fundamentals and technical procedures to assist the repairman in the maintenance and repair of helicopters. 305 pages. \$1. (Write Superintendent of Documents, Government Printing Office, Washington 25, D.C. for Pub. D 101.11:55-403)
- ( ) Light Gas Gun, a report on the high-velocity gun employing a shock-compressed light gas used by the National Aeronautics and Space Administration for launching models in its Atmosphere Entry Simulator. 18 pages. Single copies free. (Write NASA, CODE BID, 1520 H Street, N.W., Washington 25, D.C. for NASA Technical Note D-307)
- ( ) Parametric Amplifiers, a March 1959 Survey, now available, covering selected references in the field of variable-reactance parametric amplifiers. Includes a table summarizing the electrical characteristics of available devices. 5 pages. 50 cents. (Write OTS, U.S. Department of Commerce, Washington 25, D.C. for WADC Technical Note 59-90)
- ( ) Underwater Sound Transducer, a 1959 report, now available, describing development of a new, small and lightweight underwater sound transducer for use in the audio frequency range. The device is said to have a number of advantages. 16 pages. \$2.40 in microfilm, \$3.30 in photocopy. (Write Photoduplication Service, Library of Congress, Washington 25, D.C. for Navy Underwater Sound Reference Lab. Report No. 49)

